CLAIMS

1. A method of fabricating an optical sensor comprising the steps of:

providing a silicon substrate having a first surface and a second surface;

providing a region comprising essentially of silicon dioxide on or in the first surface of the silicon substrate;

etching a channel into the silicon substrate from said second surface up to said silicon dioxide region, said channel being sized to receive an optical fibre whereby said silicon dioxide region forms an end portion of said channel which at least partially closes said channel; and

coating at least a portion of the silicon dioxide region with a coating to form an environmentally-sensitive element.

2. A method of fabricating an optical sensor as claimed in claim 1, wherein the silicon substrate and silicon dioxide region form a single substrate element.

3. A method of fabricating an optical sensor as claimed in either claim 1 or 2, wherein the silicon substrate is monolithic.

4. A method of fabricating an optical sensor as claimed in any one of the preceding claims, wherein the step of providing said silicon dioxide region comprises oxidising a portion of said first surface of said silicon substrate.

5. A method of fabricating an optical sensor as claimed in any one of the preceding claims, wherein the step of providing said silicon dioxide region comprises etching at least one continuous groove in the first surface of said silicon substrate and thereafter forming silicon dioxide in said at least one continuous groove.

6. A method of fabricating an optical sensor as claimed in any one of claims 1 to 5, further comprising the step of forming at least one projection comprising essentially of silicon dioxide on said silicon dioxide region.

7. A method of fabricating an optical sensor as claimed in claim 6, wherein the step of forming at least one projection comprises providing a layer of silicon over said silicon

dioxide region; etching the layer of the silicon to form at least one structure projecting outwardly from said silicon dioxide region; and thereafter oxidising the at least one structure to form said at least one projection.

8. A method of fabricating an optical sensor as claimed in claim 6, wherein the step of forming at least one projection comprises etching the first surface of said silicon substrate to form at least one structure projecting outwardly from the silicon substrate and thereafter oxidising at least a portion of the first surface of said silicon substrate including the projecting structure to form said silicon dioxide region and said at least one projection.

9. A method of fabricating an optical sensor as claimed in either claim 7 or 8, wherein the step of etching the silicon comprises etching at least two concentric grooves to form one or more continuous projecting walls.

10. A method of fabricating an optical sensor as claimed in either claim 7 or 8, wherein the step of etching the silicon comprises etching two or more linear parallel grooves to form at least one planar projecting wall.

11. A method of fabricating an optical sensor as claimed in either claim 7 or 8, wherein the step of etching the silicon comprises etching a plurality of enclosed grooves to form a plurality of freestanding projections.

12. A method of fabricating an optical sensor as claimed in any one of claims 6 to 11, wherein the profile of the silicon dioxide projection is tapered.

13. A method of fabricating an optical sensor as claimed in any one of the preceding claims, wherein the step of coating at least a portion of the silicon dioxide region to form an environmentally-sensitive element comprises coating at least a portion of the silicon dioxide region with a luminescent material.

14. A method of fabricating an optical sensor as claimed in any one of claims 1 to 5, wherein the silicon dioxide region includes a shoulder to define a constriction at the end portion of the channel and the step of coating at least a portion of the silicon dioxide

region to form an environmentally-sensitive element comprises coating a region of silicon dioxide that closes the constricted end of the channel with a reflective material.

15. A method of fabricating an optical sensor as claimed in claim 14, further comprising the step of etching a region of silicon dioxide that closes the constricted end of the channel after the reflective material has been applied.

16. A method of manufacturing a sensor comprising the steps of:

providing a silicon wafer;

forming at least one continuous groove in a first surface of the silicon wafer;

forming silicon dioxide in said continuous groove and over the surface area of the silicon wafer encompassed by the continuous groove to form a layer of silicon dioxide;

forming a channel in the silicon wafer extending from an opposed second surface of the silicon wafer up to the base of the continuous groove containing silicon dioxide and forming a cavity beyond the channel in which the wall of the cavity is defined by the silicon dioxide provided in the continuous groove, the longitudinal axis of the channel and the cavity substantially intersecting the point of centre of the continuous groove; and

applying a reflector over at least the layer of silicon dioxide encompassed by the continuous groove.

17. The method as claimed in claim 16, wherein the step of forming the continuous groove in the silicon wafer comprises applying a mask having a ring aperture over the first surface of the silicon wafer and etching exposed regions of the first surface to form an annular groove.

18. The method as claimed in either claim 16 or 17, wherein a plurality of concentric continuous grooves are formed in the first surface of the silicon wafer, each groove having a thickness and being separation from an adjacent groove a distance selected such that oxidation of the first surface of the silicon wafer including the plurality of concentric grooves produces a silicon dioxide torus in the first surface of the silicon wafer.

19. The method as claimed in any one of claims 16 to 18, wherein the step of applying a reflector comprises coating at least the silicon dioxide layer encompassed by the continuous groove with a thin reflective film.

20. The method as claimed in any one of claims 16 to 19, further comprising the step of removing at least the silicon dioxide layer encompassed by the continuous groove after the reflector has been applied.

21. A method of manufacturing a sensor comprising the steps of:
providing a silicon wafer having a first surface and a second opposed surface;
forming a depression in the first surface of the silicon wafer;
forming silicon dioxide over the surface of the depression and at least a region of the silicon surface surrounding the depression to form a silicon dioxide membrane surrounded by a region of silicon dioxide;
etching the opposed second surface of the silicon wafer up to the silicon dioxide to fully expose the silicon dioxide membrane; and
coating the silicon dioxide membrane with a reflector,
wherein the silicon dioxide region serves as a fibre supporting structure for an end of an optical fibre.

22. A method of manufacturing a sensor comprising the steps of:
providing a silicon-silicon dioxide-silicon wafer;
etching an upper surface of the silicon-silicon dioxide-silicon wafer to form at least one silicon projection;
oxidising at least a portion of the exposed upper surface of the wafer including the silicon projection so as to form at least one silicon dioxide projection;
coating at least a portion of the silicon dioxide projection with a luminescent material; and
forming a channel in the opposed surface of the silicon-silicon dioxide-silicon wafer as far as the silicon dioxide layer, the longitudinal axis of the channel being substantially aligned with the silicon dioxide projection.

23. A method of manufacturing a sensor comprising the steps of:
providing a silicon wafer having a first surface and a second opposed surface;
etching the first surface of the silicon wafer to form at least one silicon projection;
oxidising at least a portion of the first surface of said silicon substrate including the silicon projection to form a silicon dioxide layer and a silicon dioxide projection;

coating at least a portion of the silicon dioxide projection with a luminescent material; and

forming a channel in the second surface of the silicon wafer as far as the silicon dioxide layer, the longitudinal axis of the channel being substantially aligned with the silicon dioxide projection.

24. The method as claimed in either claim 22 or 23, wherein the profile of the silicon dioxide projection is tapered.

25. A method of fabricating a plurality of optical sensors on a common substrate comprising the steps of:

providing a silicon substrate having a first surface and a second surface;

providing at least two regions each comprising essentially of silicon dioxide on or in the first surface of the silicon substrate;

coating at least a portion of each silicon dioxide region with a coating to form an environmentally-sensitive element; and

etching at least one channel into the silicon substrate from said second surface up to one or more of said silicon dioxide regions, the channel being sized to receive an optical fibre whereby said one or more silicon dioxide region forms an end portion of the channel which at least partially closes said channel.

26. A method of fabricating a plurality of optical sensors as claimed in claim 25, wherein the step of etching at least one channel comprises etching a plurality of channels, each channel being sized to receive an optical fibre and whereby each silicon dioxide region forms an end portion of the respective channel which at least partially closes said channel.

27. A method of fabricating a plurality of optical sensors as claimed in claim 25, wherein the step of etching at least one channel comprises etching a single channel optically coupled to each environmentally-sensitive element.

28. An optical sensor comprising:

a silicon substrate having a first surface and an opposed second surface;

a channel extending into the silicon substrate from said second surface, said channel being sized to receive an optical fibre and having an end portion distant from said second surface, said end portion at least partially closing said channel and comprising essentially of silicon dioxide; and

a coating disposed over at least a region of the silicon dioxide to define an environmentally-sensitive element.

29. An optical sensor as claimed in claim 28, wherein the silicon substrate and silicon dioxide forms a single substrate element.

30. An optical sensor as claimed in either claim 28 or 29, wherein the silicon dioxide includes a shoulder to define a constriction at the end portion of the channel and the coating comprises a reflective material that covers a region of silicon dioxide that closes the constricted end of the channel.

31. An optical sensor as claimed in either claim 28 or 29, wherein the silicon dioxide only partially closes the channel to create an opening in the end portion of the channel and the coating comprises a reflective material that covers a region of silicon dioxide surrounding the opening and extends over the opening.

32. An optical sensor as claimed in either claim 28 or 29, wherein said silicon dioxide comprises at least one projection and the coating is a luminescent coating applied over at least a portion of the at least one projection.

33. A sensor comprising a silicon wafer having a cavity in a first surface covered by a reflector and a channel extending from an opposed second surface of the silicon wafer to the cavity and being in communication therewith, the diameter of the channel being greater than the diameter of the cavity and the end of the channel adjacent the cavity comprising essentially of silicon dioxide.

34. A sensor as claimed in claim 33, wherein the reflector comprises a thin metal film.

35. A sensor as claimed in claim 33, wherein the reflector comprises a dielectric stack.

36. A sensor comprising a silicon wafer having at least a region of a first surface of the silicon wafer covered by a layer of silicon dioxide and at least one structure comprising essentially of silicon dioxide projecting outwardly from the silicon dioxide layer and having a luminescent material covering at least a portion of said silicon dioxide structure and a channel extending from an opposed second surface of the silicon wafer to said silicon dioxide layer and aligned with said silicon dioxide structure.

37. A sensor as claimed in claim 36, wherein the profile of said silicon dioxide structure is tapered.

38. A sensor system comprising a plurality of optical sensors on a common substrate having a first surface and an opposing second surface and a channel extending into the common substrate from said second surface, said channel being sized to receive an optical fibre, each optical sensor comprising:

an end portion distant from said second surface at least partially closing said channel and comprising essentially of silicon dioxide;

an optical coupling associated with said end portion; and

at least one of said optical sensors further comprising an environmentally-sensitive element for optical coupling with an optical fibre by means of said optical coupling.

39. A sensor system comprising a common substrate of monolithic silicon having a first surface and an opposing second surface and at least one pressure sensor and at least one optical sensor for measuring a parameter selected from temperature, fluid flow, pH, oxygen concentration, carbon dioxide concentration, glucose concentration, lactate concentration, bicarbonate ion concentration, chlorine ion concentration, sodium and potassium ion concentration,

the pressure sensor comprising:

a cavity formed in the first surface of the substrate covered by a reflector and a channel extending from the second surface of the substrate to the cavity and being in communication therewith, the diameter of the channel being greater than the diameter of the cavity and the end of the channel adjacent the cavity comprising essentially of silicon dioxide; and

the optical sensor comprising:

a layer of silicon dioxide covering at least a region of the first surface of the substrate and at least one structure comprising essentially of silicon dioxide projecting outwardly from the silicon dioxide layer and having a luminescent material covering at least a portion of said silicon dioxide structure and a channel extending from the second surface of the substrate to said silicon dioxide layer and aligned with said silicon dioxide structure.

40. A method of securing an optical fibre to a silicon block, the method comprising the steps of:

forming a channel extending into the silicon block from a surface of the block, the channel being sized so as to accommodate an end of the optical fibre;

forming an aperture in the surface of the silicon block adjacent the opening of the channel in the surface of the silicon block;

inserting an optical fibre into the channel; and

applying an adhesive to the optical fibre and to the surface of the silicon block adjacent the optical fibre and including into the adjacent aperture.

41. The method as claimed in claim 40, wherein the aperture is an annular groove encircling the opening to the channel.

42. The method as claimed in either claim 40 or 41, wherein the width of the aperture at the surface of the silicon block is less than the width of the aperture below the surface of the silicon block.